Characterization of single-crystal diamonds grown by high-growth-rate chemical vapor deposition methods

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High-quality single crystal diamonds have been obtained by microwave plasma chemical vapor deposition (CVD) with a very high growth rate, in excess of 100 μm/hr. These diamond crystals, with thickness in the millimeter range, were found to have outstanding mechanical properties before and after HPHT annealing (ref. 1). Characterization was accomplished using scanning electron microscopy (SEM), atomic force microscopy (AFM), Raman and photoluminescence spectroscopy, and X-ray diffraction. As-grown diamond crystal surfaces show feature rich surfaces with undulating waves consisting of planar slopes and rough terraces using SEM (Fig. 1) and AFM. These parallel stacking steps have a uniform separation. Analysis of rocking curves obtained by X-ray diffraction provides a comparison of the crystal qualities of the seed substrates, CVD layers (Fig. 2), and the differences of annealed superhard and ultrahard CVD diamonds.

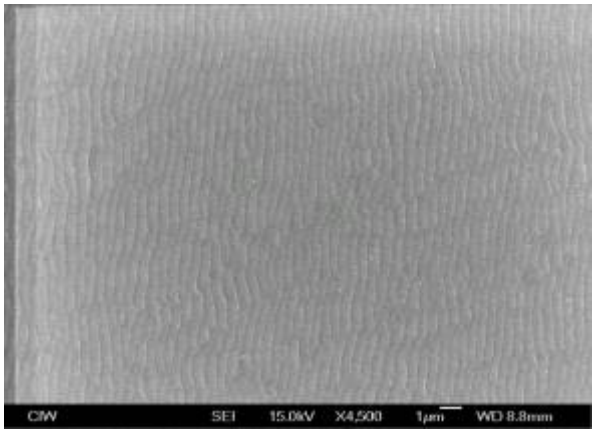

Figure 1. SEM image of typical surface morphology of an as-grown diamond single crystal

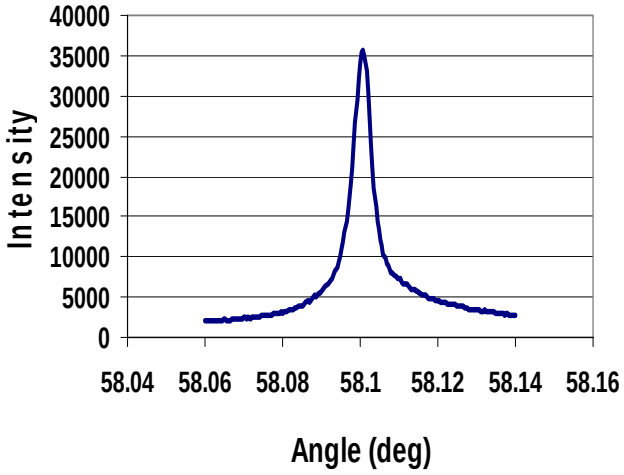

Figure 2. Rocking curve measurement of a CVD layer. A full width at half-maximum (FWHM) of 0.006° was measured, while the seed had a FWHM of 0.005°.

Reference

1. Yan, C-S., et al., "Ultrahard diamond single crystals from chemical vapor deposition," *Physica Status Solidi*, (a) Vol. 201, No. 4, R25-R27 (2004).